

Martians, Mars itself, he says, may be in a pre-biotic state, perhaps with molecules as complex as DNA surviving on the surface. The idea, Oyama admits, takes him "way out on a limb," but if future studies prove him correct, the discovery could overturn accepted theories of the origins of life on earth.

Conventional wisdom, Oyama says, has it that life on earth began in the oceans, with a pre-biotic soup of nucleotides and amino acids combining to form DNA and proteins. Oyama, however, believes that DNA formed during an earlier dry period—"the cosmologists are willing to give me 100,000 years," he says—before the primordial oceans even appeared.

The hypothesis begins with carbon suboxide ( $C_3O_2$ ), which plays a major role in Oyama's explanation of the Viking biology results. Past studies cited in the chemical literature, according to Oyama, suggest that carbon suboxide can combine with ammonia and carbon dioxide to form ring-shaped molecules similar to precursors of DNA components known as pyrimidines and purines. All of the pyrimidines and purines, he maintains, can be formed from these reactants—which he believes are or have been available on Mars—under Martian temperatures and the Martian solar-wind environment. Another important DNA component, sugar, comes, Oyama says, from the polymeric form of the carbon suboxide, hydroxylated by performate (which is formed in the atmosphere from  $CO_2$  and water under the sun's ultraviolet radiation).

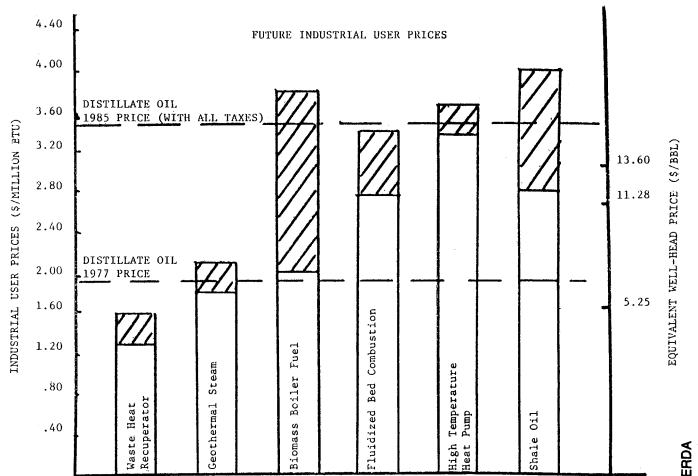
Oyama proposes that the ammonia was released into the Martian atmosphere from the breakup, during entry, of carbonaceous chondrite meteorites. The same source, he says, could have provided necessary phosphorus in a form that could combine with the precursors to link the DNA "subunits" together.

It is not possible to tell at present just where Mars stands in this complex process. The Viking lander instruments, Oyama points out, could not distinguish DNA molecules—only their components—and could miss even those if the amounts are small or irregularly distributed. Furthermore, the planet may be prevented by a variety of factors from advancing further toward the development of life. Future missions could seek DNA, however, and the idea that it could have formed "dry" would be revolutionary.

This is admittedly rather sensational stuff to have developed from such a young hypothesis, particularly one with so many unknowns. Its potential import is not too far out of scale, however, with possibilities envisioned by various researchers before the Vikings ever got to Mars. In a way, says Oyama, more stands to be learned about life's origins from the lack of Martians than from their presence. "Life," he says, "would gobble up its ancestral beginnings." □

## Carter on energy: The R&D impact

*New energy technologies would become economically feasible under Carter program.*



President Carter's recently announced energy program would not only change the kinds of fuel Americans use and the way they use them but also shift substantially the emphasis of research and development aimed at providing energy for the future. If Congress approves, Carter's program would raise the price of oil enough to make several new technologies economically competitive (see chart) and would provide new R&D funds to speed these technologies on their way to market.

Robert Fri, the acting administrator of the Energy Research and Development Administration, announced the following changes in energy R&D funding that would be brought about by the President's energy strategy. The figures represent proposed changes in outlays between the fiscal 1978 budget announced in February (SN: 3/5/77, p. 150) and those resulting from the energy message:

- Conservation, \$4.5 million (1.8 percent) increase. ERDA would work with private industry to accelerate introduction of gas-fired heat pumps into the market and save the waste heat from ERDA facilities for commercial and residential use.

- Breeder reactor, \$62 million (9.5 percent) decrease. Construction of the Clinch River prototype breeder would be deferred indefinitely, but the experimental Fast Flux Test Facility would be completed.

- Solar, \$10 million (4 percent) increase. The increase would go to expanding engineering design efforts in photovoltaic systems and for acceleration of solar energy as power for space cooling.

- Thorium fuel cycle, \$12.5 million (625 percent) increase. Breeder reactors that convert thorium to uranium are considered less of a threat to nuclear proliferation than those that convert uranium to plutonium, which can be used in bombs.

- Uranium enrichment facilities, \$91 million (6.5 percent) decrease. The decrease reflects cancellation of a proposed gaseous diffusion plant in favor of a new gas centrifuge enrichment plant, which

should cost less and use less power.

- Fossil energy, \$12 million (2.3 percent) increase. The extra funds would provide for the design of a solvent-refined coal demonstration plant and early development of eastern gas shales, which may be competitive by 1985 if prices rise.

Fri said that other major shifts of emphasis may follow in fiscal 1979, when the results are known from a current study on the effects of carbon dioxide on climate. Some scientists fear that  $CO_2$  buildup would increase the "greenhouse effect" of the atmosphere, heating the earth and even perhaps melting the polar ice caps. Since increased coal burning would result in more generation of  $CO_2$ , this study may bring about a decision to limit the expansion of coal-fired plants. Fri says this "could be to fossil fuel what proliferation was to the breeder." □

## Sexes equal in alcohol, drug use

In a scene from the new Norman Lear sitcom, "All That Glitters," the harried female executive tries to relax with a scotch and water while her male secretary gazes lovingly at her, hoping she'll ask for a date. Role transformations may not have reached that stage in real life, but it appears as though at least the alcohol aspect is close to reality.

The results of a survey of nearly 2,000 high school students in central New Jersey indicate that females may have finally caught up to males in alcohol and drug use. But according to the survey, few of the youngsters consume excessively. Researchers at Rutgers University's Center of Alcohol Studies, who conducted the study, attribute much of the "catch up" phenomenon to the movement toward equalizing male-female roles. And the trend among adults appears to be mirrored in high school youths, says Rutgers's Robert Pandina, the study's principal investigator. "There are less constraints on

females today," he says. "But along with some of the so-called blessings come some disadvantages."

One seeming disadvantage is the wider social acceptance of female drinking and drug use. According to the Rutgers survey—which questioned 1,970 junior and senior high school students in Middlesex County urban and suburban districts—two of every three students say they drink beer, wine, hard liquor or a combination of those. One of every three reports using marijuana, and almost all of those students who smoke, drink alcoholic beverages as well, reports the study, which was funded by the New Jersey State Department of Health and the National Institute on Drug Abuse.

In both cases, the percentages were almost identical for males and females—confirmation, according to Pandina, that young women are "catching up" with men. A decade ago, similar studies showed that while 65 to 85 percent of males said they drank, only 50 percent of the females classified themselves that way, Pandina says. "We've seen the trend (of females catching up) since the late '60s," says the psychologist. "Now it appears as though females are on a par." Pandina says the Rutgers findings are consistent with other recent results.

But along with the rise in female alcohol and drug consumption has come the

evolution of a more sophisticated set of youngsters who do not appear to consume excessively. In the Rutgers survey, only one in seven of those sampled say they drink beer or smoke marijuana at least several times a week. One in 18 say they drink wine or liquor with the same frequency. When asked about the use of other substances at least several times a week, 1 in 40 replied they use amphetamines, and 1 in 100 said they use barbiturates. Six of all students use hallucinogens, four use inhalants and just two use opiates. Since some of the students are multidrug users, there is considerable overlap in the figures, the scientists report.

The researchers were somewhat surprised at the early age—12 to 13 years—that many of the youngsters began using marijuana. "The first use of marijuana now appears to coincide with the first use of alcohol," Pandina notes. Not too long ago, marijuana was primarily confined to college campuses, he says. Pandina suggests that earlier use could lead to more extensive smoking as adults.

Also unexpected was the finding that 10 to 15 percent of the youngsters report some experience with cocaine. This surprised the researchers because cocaine is an expensive drug that requires a street contact, and most of the youngsters surveyed were from "standard, blue collar communities." □

The slave-making workers raid nests of ants of other species to get slaves to care for the queen and her brood. These slaves have no stake in the sex ratio of the ants they rear, but the queen, as always, prefers a 1:1 ratio. The investment of care in the offspring is about equal for the two sexes in two slave-making species. Trivers and Hare reported.

Other biologists challenge the conclusion that workers interests are actually being realized contrary to the queen's interest. Richard D. Alexander of the University of Michigan and Paul W. Sherman of the University of California at Berkeley publish their argument in the April 29 SCIENCE. They object on two levels: The data given by Trivers and Hare are insufficient to establish the ratio of investment in the different ant colonies, and there is another theory better able to explain the data that Trivers and Hare report.

Alexander and Sherman believe that the simplifying assumptions the Harvard biologists made were not justified. They point out evidence for multiple matings by queens and the ability of workers to lay eggs that hatch into males. They also find fault with the researchers' selection of specimens and statistical methods.

Alexander and Sherman propose another hypothesis that they feel better fits the collected data. Rather than the workers triumphing over the queen on the matter of sibling care, the critics suggest that the observed sex ratios actually do benefit the mother's genes.

Sexual competition among genetic relatives might make parents adjust their investments in offspring of each sex. For example, if a female produced two sons that competed only with each other for every mate, they would be of no more value to her than a single son. In the extreme case, if all matings were between brothers and sisters, the most economic parent would produce only enough sons to fertilize all the daughters. This could give a male-to-female ratio as high as 1 to 46, Alexander says. Because the data for single-queen ant colonies gives a sex investment ratio of more than 1 to 3, Alexander says, sibling mating is a better explanation than offspring dominance.

Trivers disagrees. The alternative hypothesis, he told SCIENCE NEWS, requires a degree of inbreeding that is virtually unknown except in very specialized species and would be biologically absurd among ants that go to much trouble to avoid siblings mating in the nest. "It's just exceedingly unlikely," he says.

Of the other criticisms, Trivers says, "I honestly think Alexander's remarks are largely trivial and they will be shown to be trivial by more careful studies in the future." Although he agrees that the methodology of his study was rough in particular parts, Trivers says, "I think it was remarkably successful and, by the standards of evolutionary biology, a very sophisticated test." □

## Genetics of generation gap in insects

Conflicts between parents and their offspring are certainly as old as the history of man and even extend back through the history of insects. Biologists have been examining this basic problem of family life among insects living in different social situations. The scientists are looking for general principles that will explain how natural selection affects the evolution of social behavior.

The area of conflict between parent and offspring of social insects involves care of siblings. Because of a peculiarity of inheritance among the group of insects that includes bees, ants and all social insects except termites, the genes of the mother will be most widely propagated if she produces approximately equal numbers of males and females. In contrast the genes of her daughters, the workers in the insect colony, are best served if the workers take better care of their sisters than of their brothers.

The reason for this asymmetry is that among Hymenoptera insects, full sisters share, on the average, three-fourths of their genes, while a sister is related to her brother by only one-fourth. (The difference arises because males develop from unfertilized eggs and have only one set of genes, while females develop from fertilized eggs and have two sets.)

Kinship theory, proposed in 1964 by W. D. Hamilton of the University of

London, and recently popularized by Edward O. Wilson in *Sociobiology* (SN: 11/29/75, p. 347), is an explanation of why animals may have an evolutionary advantage if they sometimes forego acting selfishly in order to benefit the survival of others. The theory predicts that the amount of effort one organism expends aiding another will be proportional to the closeness of their genetic relationship. The Hymenoptera workers would best invest three times as much effort in raising sisters as in raising brothers.

Robert L. Trivers and Hope Hare of Harvard University reported last year that an analysis of a wide range of data collected by different researchers indicates that offspring can act counter to their parents' best interests. "The queen's royal status flows from her unique genetic role, but this role does not give her royal powers—at least not where care for her offspring is concerned," they conclude in the case of single-queen ant colonies (SCIENCE 191, 249, 1976). For 21 ant species, the investigators graphed the weights and sexes of the offspring that will reproduce, as an estimate of the care (feeding) they had received. All the species invested more in females, and the ratio was near 1 to 3, as would benefit the genes of the workers.

Trivers and Hare contrasted this situation with that among slave-making ants.